EXHIBIT 16

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

JOSEF A. KOHEN, BREAKWATER TRADING LLC, and RICHARD HERSHEY, Plaintiffs, v. PACIFIC INVESTMENT MANAGEMENT COMPANY LLC, and PIMCO FUNDS, Defendants.	)	No. 05 C 4681 Judge Ronald A. Guzman Magistrate Michael T. Mason

REBUTTAL EXPERT REPORT OF DR. CRAIG PIRRONG

I. INTRODUCTION

1. This rebuttal report is submitted in accordance with FRCP 26(a)(2)(C).

2. In rebuttal to defendant's expert Dr. Steve Hanke's opinions designed to show that defendants did not cause artificial inflation in the June contract prices, I offer the following opinions and reasoning.

3. The report submitted by Dr. Hanke is rife with conceptual, logical, economic, and data errors. As a result, the opinions he offers are unreliable.

4. Some of Dr. Hanke's errors relate to very fundamental concepts. For example, he is very confused—and wrong—on simple concepts such as the net basis, and swap spreads. These concepts should be of second nature to anyone familiar with the operation of the Treasury markets. He also makes numerous data errors, such as omitting the bulk of CBOT Treasury Note futures trading from his volume calculations,

and double counting repo transactions on numerous dates throughout the class period. He also makes inapt comparisons (such as drawing inappropriate analogies between commodities and financial instruments). His Granger Causality analysis focuses on the wrong variables, and utilizes flawed data. He also omits crucial facts from his analysis (such as his failure to analyze the course of the prevailing market price when PIMCO liquidated its position.)

5. Dr. Hanke makes fundamental errors in his analysis of price artificiality, causation, manipulative acts and intent, and damages. I address each of these issues in this rebuttal report.

6. After reviewing Dr. Hanke's report and his deposition, I reaffirm the opinions I expressed in my original report to the effect that PIMCO deliberately engaged in manipulative acts, and thereby caused the price of the June, 2005 Ten Year Treasury Note futures contract ("the June Treasury Note futures" or "June futures" hereafter) to be artificial during the class period.

7. Generally, I am compelled to point out that manipulation is a specialized area. Whereas I have written seven peer reviewed articles, a book, and a law review article on manipulation, Dr. Hanke admits that he has never published an article on the subject.[1] Moreover, whereas I have served as an expert in manipulation cases, Dr. Hanke admits that he has not.[2]

II. ARTIFICIALITY

8. In his expert report, Dr. Hanke concedes that June contract prices were excessively rich, and that on that contract, PIMCO took the largest deliveries in the history of the

[1] Deposition of Dr. Steve H. Hanke, at 5. ("Hanke deposition" hereafter.)
[2] Id.

T-Note futures contract. However, Dr. Hanke offers various opinions that somehow PIMCO itself did not cause the June contract prices to be artificial. In my opinion, Dr. Hanke's analysis of artificiality is rife with errors, and hence is unreliable.

9. Dr. Hanke opines that a negative basis net of carry ("BNOC") is not symptomatic of price artificiality. His opinions are fundamentally flawed.

10. In his report, Dr. Hanke asserts that a negative BNOC is equivalent to a negative equilibrium rate for a repurchase agreement involving the CTD note with the "same term" as the futures contract. He says: "the repo rate should be equal to . . . the basis net of carry for the Treasury future versus the cheapest to deliver underlying security."[3] He also states "because the repo rate should be equal to the basis net of carry of a similarly-dated future with the same underlying deliverable security, a negative equilibrium net basis (basis net of carry) in equilibrium in the futures market."[4] Elsewhere, he opines that "one would expect a negative net basis to prevail whenever the repo rate for the same security and same term is negative."[5] In my opinion, Dr. Hanke's analysis is irrelevant, and logically flawed.

11. A negative equilibrium repo rate is possible in the Treasury market even though the market repo rate for non-guaranteed repo cannot fall below zero. However, if the market rate is positive, the equilibrium rate cannot be negative. Although the repo rate on loans collateralized by the CTD note for "the same term" as the June futures (i.e., repo loans maturing on 30 June, 2005) was special during the class period, it was almost always positive. Hence, the equilibrium repo rate could not have been negative on many times when the BNOC was negative. Therefore Dr. Hanke's

[3] Expert Report of Dr. Steve H. Hanke, at 6. ("Hanke report" hereafter.)
[4] Id., at 9.
[5] Id., at 61.

cannot evoke a negative equilibrium repo rate to explain the negative BNOC even if his theoretical analysis was logically correct.

12. However, Dr. Hanke's argument is also theoretically incorrect. The net basis and repurchase rates are stated in different units. Therefore, Dr. Hanke's claim that "the repo rate should be equal to . . . the basis net of carry for the Treasury future versus the cheapest to deliver underlying security" is necessarily incorrect. Further, it is nonsensical for Dr. Hanke to equate percentages and absolute dollars. Most tellingly, the existence of a negative equilibrium term repo interest rate (which I reiterate could not have existed during the class period in any event) does not imply a negative BNOC.

13. The BNOC is (a) the full price of the CTD bond, (b) minus the invoice price of the future, (c) minus interest accrued on the bond from the calculation date through delivery, (d) plus financing costs. If (a) the futures price reflects a negative equilibrium interest rate, but (b) one uses the zero market rate to calculate the BNOC, the BNOC will be positive, not negative. This occurs because the BNOC is zero when calculated using the equilibrium interest rate, and by using the higher market rate to calculate financing costs, these costs are overestimated. This overestimate of the financing costs leads to an upward bias in the calculated BNOC. The equilibrium BNOC is zero (using the appropriate equilibrium rate) hence the BNOC calculated using the above-equilibrium market rate must be positive since it is biased upwards

14. If a negative equilibrium repo rate is impounded in the futures price, the implied repo rate should equal this negative, equilibrium rate. However, during the class period, the implied repo rate was positive. Indeed, it was typically higher than the general

collateral rate. That is, whereas a negative equilibrium interest rate tends to drive the futures price down relative to the price of the CTD, the pricing anomaly during the class period is that the futures price was atypically high relative to the price of the CTD. The high implied repo rate and the negative BNOC were both symptoms of this atypically high price of the future relative to the CTD.

15. In sum, (a) the equilibrium 30 June, 2005 term repo rate for the February, 2012 note was not negative during the class period, and hence cannot explain the existence of a negative BNOC, and (b) even if the equilibrium repo rate had been negative, logically it could not have caused the BNOC to be negative.

16. Similarly, in his deposition, Dr. Hanke reasoned that his interpretation of the relationship between a negative equilibrium repo rate and a negative BNOC is "consistent with" what was written in an article by Fleming and Garbade.[6] However, although Fleming and Garbade discuss negative equilibrium repo rates, they nowhere discuss the net basis, or even futures contracts. Hence, in my opinion, this article clearly does not even begin to support Dr. Hanke's linkage of negative equilibrium repo rates and a negative BNOC.

17. Dr. Hanke also offers other arguments to support his contention that the negative BNOC was not symptomatic of price artificiality. All of these arguments are flawed.

18. For instance, he draws an analogy between backwardation in commodity markets and a negative BNOC.[7] In my opinion, this analysis is completely defective.

19. First, the analogy is not relevant. Commodities are not truly assets, as they are not always in positive net supply, whereas a particular issue of a Treasury note is in

[6] Michael J. Fleming and Kenneth D. Garbade, Repurchase Agreements With Negative Interest Rates, 10 Current Issues in Economics and Finance (2004) 1. Hanke deposition, at 54.
[7] Hanke report, at 61.

positive net supply until it matures. Hence, contrary to Dr. Hanke's fanciful assertion[8], there can never be a "stockout" in a Treasury note. Therefore, any analogy with commodities for which such stockouts can occur is completely misguided.

20. Second, Dr. Hanke's assertion that a "natural outcome" of a situation where the current yield on the CTD note exceeds the financing cost is for the market "to show a negative net basis"[9] is just plain wrong. When the current yield exceeds the financing rate on the CTD the market is in backwardation (i.e., the futures invoice price is less than the full price of the note), but this only means that the *gross basis* is *positive*. The net basis adjusts for coupon income and financing costs, so a positive gross basis (backwardation) in no way implies a negative net basis. Indeed, in a competitive market, the net basis should be positive (due to delivery options) regardless of the sign of the gross basis (i.e., regardless of whether the market is contango or backwardation).

21. Dr. Hanke asserts that Dr. Merrick and I ignore convenience yield and liquidity premia in our analysis of the BNOC. This is incorrect. As Dr. Darrell Duffie notes in his article on special repo rates,

> "[o]ne may view repo specialness as a form of 'convenience yield' in forward or futures markets. Forward prices are often depressed by an apparent advantage, beyond the dividend cash flow (net of storage costs) paid directly by the asset, of ownership and control of the underlying asset during the time period before delivery of a forward contract.[10]

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[8] Id., at note 47. I am also unaware of any academic literature which equates the cost of a stockout to the cost of a delivery failure.
[9] Id., at 61.
[10] Darrell Duffie, Special Repo Rates, 51 J. of Fin. (1996) at 497.

22. Dr. Duffie also states "[o]ther things being equal, one would expect that the more liquid of two instruments to be the more special in repo."[11]

23. Since (a) Dr. Merrick and I both use the special repo rate for the February, 2012 note when calculating the net basis, and (b) since per Dr. Duffie this special repo rate captures any convenience yield and liquidity premium effects, we most decidedly did take these considerations into account.

24. In sum, Dr. Hanke's opinion and analysis of the BNOC in no way demonstrate that this phenomenon could be observed in a competitive, unmanipulated market, but they do demonstrate that Dr. Hanke misunderstands fundamental concepts regarding the trading, operation and valuation of Treasury notes and Treasury note futures contracts. Dr. Hanke's errors and omissions further support my original opinion that the negative BNOC was highly anomalous, and most reasonably explained as the result of manipulation of the June, 2005 Treasury Note futures contract.

25. Dr. Hanke asserts that Dr. Merrick and I "beg the question" of why pricing of the June futures departed from the cost-of-carry model.[12] We do nothing of the sort. Our reasoning is clear. In a competitive market, Treasury futures should be priced according to the cost-of-carry model—which implies a zero BNOC (or positive BNOC, if delivery options are valuable.) We observe a negative BNOC. This is inconsistent with competitive pricing. It is consistent with what one would expect to observe during a market power manipulation. It is Dr. Hanke who ultimately begs the question of why the` BNOC was negative. In my opinion, this, again, is because none of his explanations for a negative BNOC make the slightest sense.

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[11] Id., at 523.

[12] Hanke report, at 58.

26. Dr. Hanke asserts that I failed to show that the artificiality figures calculated in my report are statistically significant. First, these figures were statistically significant on many days during the class period. Second, as I stated in my original report, the artificiality figures derived from the analysis of the BNOC and the pricing of the CTD note mirrored those derived from the analysis of swap spreads. These points strongly suggest that it is far less likely that the latter artificiality figures would have been observed by chance in a competitive market than the p-values would suggest.

27. Third, during my deposition, in response to a question from defendant's attorney I stated that I was working on a Bayesian econometric analysis to formalize this foregoing suggestion. I have completed that analysis.[13] It demonstrates that the probability that the true artificiality was zero on almost all days of the class period was far below conventional significance levels. Hence, contrary to Dr. Hanke's assertion, the June futures price was artificial by a what is conventionally regarded to be a statistically significant amount on almost all days of the class period.

28. Bayesian analysis provides a rigorous method to combine data from multiple sources. That is, in a Bayesian analysis, one combines information derived from one set of data ("the prior") with another data set to derive a "posterior" distribution of the parameters of interest. In the present instance, I utilized the data on the BNOC and the pricing of the CTD note derived from the analysis of butterfly spreads to postulate a prior estimate of the probability distribution of artificiality on each day of the class period. I set the mean of the distribution on each day to the sum of the BNOC and the inflation in the CTD note implied by the deviation of the butterfly spread from its pre-class period average. I calibrated the variance of these distributions to the bid-ask

[13] Pirrong deposition, at 200.

spread and the variability of the butterfly spread (converted to dollars by use of the DV01.) Then, I followed the standard Bayesian procedure for a regression with autocorrelated errors (based on a Gibbs sampler) to estimate the posterior distribution of the regression coefficients—including the artificiality coefficients—of the cointegrating regression described in my original report.[14]

29. Exhibit R1 reports the mean value of artificiality implied by the posterior distribution for each day of the class period, and the probability that the artificiality on each day was less than or equal to zero. The artificiality estimates are quite similar to those in Exhibit 4 of my original report. Moreover, note that for all days of the class period except the first—9 May, 2005—this probability is less than 5 percent. On most days of the class period, this probability is zero to the fourth significant digit.

30. Again, this method combines information from a variety of sources—the BNOC, the butterfly spread, and swap spreads. It therefore reflects a more complete picture of artificiality than any one of these measures by itself. In my opinion, this Bayesian analysis provides strong evidence that for all but one day during the class period, it was extremely unlikely that there was no artificiality in the June futures price. As to that one day, there is still strong evidence for artificiality; one can reject the null hypothesis of no artificiality at a p-value of 6.1 percent, only slightly above the conventional 5 percent level of significance, but well below the also conventional 10 percent level.

31. The artificiality estimates contained in my original report are statistically indistinguishable from those produced by the Bayesian analysis. In sum, therefore,

[14] For a description of this method, see Gary Koop, Bayesian Econometrics (2003), at 130-136.

this augmented analysis supports the finding that prices were artificial by the amount set out in my original report.

32. In my opinion, the artificiality numbers produced by the Bayesian analysis are reasonable, and derived from a rigorous methodology. Inasmuch as the classical statistical methods that I employed to derive the artificiality estimates in my original report: are more widely utilized by economists and econometricians than Bayesian techniques in both academic research and litigation; were utilized in my peer reviewed work on manipulation; and, in this instance are more conservative; in my opinion the artificiality estimates presented in my original report are the best to utilize in this case.

33. Dr. Hanke argues that the price relations observed in the market in May-June, 2005 (including the negative net basis, and special repo rates) were due to a shortage of the CTD note arising from structural conditions.[15] He also says that a "scarcity of supply" is due to "excess demand."[16]

34. Dr. Hanke presents no detailed analysis of the source of the "excess demand" for the CTD note. This is understandable, as there was only one major demander of the CTD note in the cash market, and via the delivery process—PIMCO. At the end of the delivery period, through cash market purchases, deliveries, and reverse repo transactions, PIMCO had amassed over 80 percent of the CTD issue—and 100 percent of the float in that instrument. There was no broad-based demand for the note. PIMCO was the only demander of large quantities of it. Therefore, any "excess demand"—and the price effects thereof—are attributable to one firm: PIMCO.

[15] Hanke report., at 3, 7, 14, 35, 59, 67.
[16] Id., at 7.

35. My reasoning for this conclusion includes the facts that PIMCO admits it was the only firm operating from its economic playbook[17], and PIMCO's internal emails. The latter reveal an intent to cause price increases from 9 May, 2005 forward.

36. In my opinion, Dr. Hanke's claim that my analysis of repo specialness of the CTD "is misleading"[18] is itself misleading. My analysis was specifically focused on the CTD, which is the relevant comparison in this context. In his lame attempt at rebuttal, Dr. Hanke cites the example of the 3.625 percent note of May 2013 to claim that the repo specialness of the February 2012 note was not particularly unusual. This is a <u>non sequitur</u>, because the 3.625 of May 2013 was not the CTD note against any futures contract, and was an on-the-run security; on-the-runs are more likely to be special than old, off-the-run notes like the February 2012. Moreover, the Fleming-Garbade article that Dr. Hanke relies upon for this analysis only provides information on the overnight repo rate, not the term rate; my analysis focused on a term rate. That is, rather than comparing apples-to-apples, as I did, Dr. Hanke compares apples to oranges. This is misleading. Dr. Hanke also fails to note that the maximum specialness in the February, 2012 term repo rate was approximately equal to the maximum overnight repo specialness experienced by the 3.625 of May 2013, a level that was considered exceptional.[19]

37. Dr. Hanke's critique of my econometrics work is baseless. For instance, he criticizes my use of dummy variables.[20] His specific criticism is incomprehensible, but I can say that (a) there are <u>a priori</u> reasons why the relation between the futures swap

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[17] Zhu deposition, at 322-323.
[18] Hanke report, at 8.
[19] Fleming and Garbade, <u>supra</u> note 6.
[20] Id., at 55.

spread and the on-the-run swap spreads may change from contract-to-contract (due to, inter alia, changes in the identify of the CTD note, changes in the yield curve), (b) the dummy variable specification allows for such changes, and (c) several of the dummy variables are statistically significant, and statistically different from one another. This means that excluding such time varying effects would result in a specification error. Indeed, my estimates of artificiality would be higher if I were to omit the dummy variables. Therefore, my method is conservative and actually works in defendants' favor. That is, contrary to Dr. Hanke's assertion that my estimates of artificiality are "strongly biased upwards" by the inclusion of dummy variables[21], the exact opposite is the case.

38. Dr. Hanke also argues that since volatility likely changed from day to day, my estimates of significance are biased upwards.[22] He points specifically to the large increase in artificiality on 24 May, 2005.[23] This reflects a fundamental misunderstanding of the relevant methodology—a methodology set out in my peer reviewed research. This involves comparing the level of estimated artificiality to some measure of variability of the relative price in *unmanipulated* conditions. This is exactly what I did. In making this comparison, it is appropriate to exclude the possibly manipulated prices when calculating the measure of variability under unmanipulated conditions; indeed, including such data would involve circular logic.

39. Dr. Hanke provides no evidence of "systematic factors" that would have caused the swap spreads to "[depart] from the norm" in May-June, 2005.[24] He provides no

[21] Id.
[22] Id., at 56.
[23] Id.
[24] Id., at 62.

explanation as to why there were different "economic forces driving one particular Treasury security."[25] One of the factors he mentions is repo market specialness—but he does not identify what competitive economic forces caused such specialness for that security, but not others. He also refers to the February, 2012 note's status as CTD, and what he says was its relative scarcity. But again, Dr. Hanke provides no analysis of the source of this relative scarcity, or why a note's status as CTD—absent any manipulative pressure—would cause its pricing to "depart from the norm." Its status as CTD only mattered to the extent that the demand for it could be satisfied through the delivery process. PIMCO was the only firm that took large deliveries of the note. But for PIMCO, the February 2012 note's CTD status would have been immaterial as there would have been no substantial demand for it. That is, as I show supra, any "scarcity" of the CTD note was due to one thing and one thing only—PIMCO's threatened and demand for excessive deliveries.

40. Moreover, Dr. Hanke's analysis does not explain why the BNOC was negative (i.e., why the June future was rich relative to the CTD), or why the futures swap spread (which is the basis for my artificiality numbers in Exhibit 4, and which incorporates the effect of both the pricing of the CTD and the BNOC) was abnormally wide. If for some strange reason market participants really wanted the February, 2012 note, they would have bid up its price in the cash market without causing the net basis to go negative; given the pricing structure in the market, the June futures was an expensive source of the CTD note that Dr. Hanke claims was in such high demand. Put differently, putatively high demand for the CTD note cannot explain why the futures—and the futures swap spread—was expensive relative to the CTD.

[25] Id.

Manipulation of the futures explains such a divergence between the future and the CTD. Hence, although Dr. Hanke's theories cannot explain the "departure" of the futures swap spread "from the norm," manipulation can—and in my opinion, does.

III. CAUSALITY

41. Dr. Hanke relies on a purported lack of a Granger Causal connection between Treasury futures prices and PIMCO trading to opine that PIMCO did not cause an artificial price. Dr. Hanke's analysis is flawed and incomplete. He responds to a question that I did not raise, and he fails to find Granger Causality because he misapplied the test.

42. In my deposition, I testified that Granger Causality analysis of manipulation often suffers from a serious lack of statistical power. That is, it poses a serious risk of failing to find a causal relationship, even when such a relationship exists. Put differently, "false negative" results are potentially a serious problem in Granger Causality analysis applied to manipulation.

43. This occurs for a variety of reasons. It is information that moves prices, and there is no necessary linkage at fixed time intervals between a manipulator's trading and the revelation of information about that trading, or the trader's likely future actions. Moreover, Granger Causality looks at the relation between contemporaneous price changes and lagged changes in independent variables (PIMCO trading, in this instance.) Dr. Hanke utilizes daily price changes. If information on trading occurs within a day, even if this information moves prices, a proper Granger Causality analysis will fail to establish this connection.[26] Finally, although the salience of trade-flow information can vary through time, with the consequence that a given trade can have different price

[26] C. W. J. Granger, Testing for Causality: A Personal Viewpoint, 2 J. Econ. Dynamics & Control (1981), at 340.

impacts at different points in time, Granger Causality implicitly assumes that all trades have the same impact. As a result, if a specific trade is deemed particularly informative by market participants but other trades are considered less informative, Granger Causality analysis may fail to identify that especially salient trade because it effectively identifies the average impact of a trade on prices.

44. In my peer reviewed research, I showed that the application of fundamental economic principles can be used to establish causation. I utilized those very principles in my expert report.

45. This paucity of power in Granger Causality tests is likely to be particularly pronounced when one uses, as Dr. Hanke does, changes in the futures price as the dependent variable, and fails to include other independent variables that control for the myriad other factors that can affect Treasury futures prices.

46. Dr. Hanke concedes that Treasury futures prices move for reasons other than PIMCO trading.[27] Yet he made no effort in his Granger Causality analysis to control for these other sources of price movements. Indeed, in his deposition, he made the bizarre—and unsupported—claim that by running his regression on prices and including only PIMCO position variables as independent variables that he used "total information."[28] His information set was anything but complete as it did not include any variables that could control for the influence of other factors (e.g., policy announcements, releases of government statistics, market news broadly construed) on the price of the June future.

47. By failing to correct for other factors that can influence prices, Dr. Hanke sharply reduces the power of a Granger Causality test. The signal being sought—the influence

[27] Hanke deposition, at 82.
[28] Id., at 98.

of PIMCO trading on prices—is likely to be overwhelmed in the cacophony of other information flows that affect prices.

48. Even more importantly, it was and is incumbent on Dr. Hanke to answer the specific question and test the specific prediction that I made in my report. In my report—as in my peer reviewed academic research—I was quite specific that the alleged manipulation would be expected to affect the price of the June future *relative* to the price of other instruments. Indeed, I explicitly stated that a market power manipulation[29] of the type plaintiffs allege would *cause **relative** price movements*:

> Specifically, long manipulation *causes* the price of the future, and the price of the cheapest-to-deliver instrument, to rise *relative* to the prices of other, related instruments.[30]

49. By focusing on relative prices, one controls for the myriad other factors that can influence the June futures price. For instance, news on monetary policy changes, economic growth, inflation, and other value-relevant variables, affects swap yields, and the yields of on-the-run Treasuries as well as the June futures price. Examining the movement of the June futures price (or the June swap spread) relative to other prices (or other swap spreads) identifies the movements that are unique to the June futures. This controls for the effect of information that affects prices generally.

50. In my report, I document that the June futures price did indeed rise relative to the price of comparable instruments during the class period. In my opinion, these relative price distortions are price "artificiality," caused by PIMCO

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[29] During his deposition, Dr. Hanke seemed mystified by the concept of market power manipulation: "I don't know exactly what you mean, to execute a market power manipulation." Id., at 220. This despite the facts that: (a) Plaintiffs specifically allege this type of manipulation, (b) my expert report explicitly states that this is the kind of manipulation that PIMCO completed, and (c) my book that Dr. Hanke cites includes "market power manipulation" in the title, and analyzes this type of manipulation in detail.

[30] Pirrong report, at ¶39. Emphasis added.

51. I have written in multiple peer reviewed publications that manipulation affects **relative** prices, and hence should be the focus of any analysis of price artificiality.[31]

52. Therefore, inasmuch as I specifically—and quite intentionally—opined that manipulation should cause movements in relative prices, and raised the question of relative prices, Dr. Hanke should have constructed his Granger Causality tests to determine whether PIMCO trading Granger caused changes in *relative prices*—that is, whether this trading Granger caused changes in *artificiality* (i.e., in relative prices). Dr. Hanke did not do so; he looked at changes in the level of the June futures price, not changes in the level of that price relative to the prices of other comparable instruments. Thus, his analysis is pointedly unresponsive to the analysis in my report, and to plaintiffs' allegations. Consequently, his Granger Causality analysis is completely unreliable as a basis for evaluating the validity of my conclusions, and of plaintiffs' allegations.

53. Moreover, it is incorrect to assert (as Dr. Hanke does) that a Granger Causality analysis must logically precede quantification of artificiality. Since as I noted in my report (and in my academic research) manipulation causes changes in relative prices, a proper Granger Causality analysis must focus on those relative price changes. As noted supra, in my opinion these relative price changes are artificial. Granger Causality analysis tests whether A causes B. Implementation of Granger Causality testing requires quantification of both A (the purported cause) and B (the alleged effect). Economic

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[31] Stephen Craig Pirrong, The Law, Economics, and Public Policy of Market Power Manipulation, at 153-158. Craig Pirrong, Detecting Manipulation in Futures Markets: The Ferruzzi Soybean Episode, 6 American Law & Econ. Rev. (2004), at 32-33. In that article I make 88 references to the use of relative prices in detecting manipulation.

theory says that in this case, "B" is a change in relative prices, so that is the appropriate—and logical—focus of a Granger Causality analysis.

54. A fair reading of Dr. Christopher Gilbert's Class Certification Report also demonstrates that Dr. Gilbert opined that Granger Causality analysis should examine whether PIMCO trading Granger caused changes in artificiality. Thus, although Dr. Hanke asserts that he is merely implementing Dr. Gilbert's suggestion when he performs Granger Causality analysis, this assertion is incorrect. Whereas Dr. Gilbert stated that Granger Causality analysis should be performed using artificiality as the dependent variable, Dr. Hanke eschewed this recommendation and performed his analysis on prices instead.[32] In my opinion, it is misleading for Dr. Hanke to state that he is merely following Dr. Gilbert's recommended methodology.

55. In response to Dr. Hanke's fundamentally flawed and incomplete Granger Causality analysis, I have performed Granger Causality tests to determine whether PIMCO trading caused changes in the artificiality of the June futures price. I find that: (a) PIMCO's trading in futures and the CTD note was contemporaneously correlated with changes in artificiality during the class period; (b) these contemporaneous correlations are statistically significant; (c) PIMCO's futures and CTD trading Granger caused changes in the artificiality of the June futures price; and (d) Citadel trading (measured by changes in its futures position, CTD note position, and amount of the CTD lent out) did NOT Granger cause changes in artificiality. The data reject the hypothesis of no Granger

[32] Dr. Gilbert stated "I may need to establish whether and to what extent any *artificiality* in the price of the June or mispricing of the 2012 note is the result of defendants' alleged manipulative activities . . . . Economists routinely use Granger causality analysis for demonstrating probable causal effect. This is a regression based technique. . . . one can use standard regression techniques to quantify the extent that price *artificiality* result from defendants' alleged manipulative actions." Affirmation of Professor Christopher L. Gilbert, at 8. Emphasis added. Thus, Dr. Gilbert specifically states that he would look for evidence that **artificiality** resulted from defendants' activities, and that his regression technique would quantify the extent to which **artificiality,** not changes in absolute prices, resulted from these activities.

causality relations between artificiality changes and changes in PIMCO's CTD and futures position at very high levels of statistical confidence; the probability of a "false positive" result is as low as .0001 (one out of 10,000), far below the standard 5 percent confidence level conventionally used to assess statistical significance. In contrast, the hypothesis that PIMCO's CTD repo activity or Citadel's trading did not Granger cause changes in cannot be rejected at any conventional significance level.

56. These results are set out in Exhibits R2-R7.

57. Exhibit R2 presents the results of a regression of the change in futures artificiality presented in Exhibit 4 of my original report (DFYART) on the contemporaneous change in PIMCO's position in the CTD note (DCTDPOSITION), the contemporaneous change in PIMCO's June Futures position (DFPOSITION), and the contemporaneous change in PIMCO's repo lending of the CTD note (DREPOPOS). The coefficient on the change in PIMCO's CTD note position is positive and significant.

58. Exhibit R3 presents the results of a Vector Autoregression (VAR) involving four variables: DFYART, DCTDPOSITION, DFPOSITION, and DREPOPOS. In the DFYART equation (the artificiality equation), one can *reject* the null hypothesis that the change in PIMCO's CTD position does *not* Granger cause the change in artificiality at a p-value of .007 (.7 percent) far below the conventional 5 percent significance level. Similarly, one can decisively reject the null hypothesis that the change in PIMCO's futures position does *not* Granger cause the change in artificiality. Thus, these results imply that changes in PIMCO's CTD and futures positions Granger caused the change in artificiality. Although the change PIMCO's CTD repo position did not Granger cause

the change in artificiality, one cannot reject the null that the change in PIMCO's repo position does not Granger cause the change in artificiality.

59. Exhibit R4 presents the results of a regression of DFYART against current and two lagged values of DCTDPOSITION, DFPOSITION, and DREPOPOS. One can reject the null hypothesis that the coefficients on current and lagged values of DCTDPOSITION are all zero at a high level of confidence. Similarly, one can reject the null hypothesis that the coefficients on current and lagged values of DFPOSITION are all zero at a high level of confidence. However, one cannot reject the null hypothesis that the coefficients on the current and lagged values of DREPOPOS are collectively zero.

60. Exhibit R5 presents the results of a regression of DFYART against contemporaneous values of DCTDPOSITION and DFPOSITION, and three variables measuring Citadel's trading activity: the change in Citadel's futures position (DCITADELFPOS), the change in Citadel's holdings of the CTD note (DCITADELCTDPOS), and the change in the amount of the CTD note that Citadel did not lend out (DCITADELNOLEND).[33] The two PIMCO position variables are statistically significant and positive. One cannot reject the null hypothesis that all of the Citadel position variables are zero. Thus, whereas variations in PIMCO's futures and CTD positions do explain variations in artificiality, variations in Citadel's positions do not.

61. Exhibit R6 presents the output of the estimation of a VAR on DFYART, DCTDPOSITION, DFPOSITION, DCITADELFPOS, DCITADELCTDPOS, and

[33] All Citadel trading information is taken from an exhibit employed by Defendants. The analysis presented herein assumes that these numbers are accurate, but I do not vouch for their accuracy. I reserve the right to amend this rebuttal report if these data are not an accurate representation of Citadel's trading activity.

DCITADELNOLEND. One can decisively reject the null hypothesis that DCTDPOSITION does not Granger cause changes in artificiality. Similarly, one can decisively reject the null hypothesis that DFPOSITION does not Granger cause changes in artificiality. However, one cannot reject the null hypothesis that any of the Citadel trading variables Granger cause changes in artificiality. Thus, whereas PIMCO trading did Granger cause changes in artificiality, Citadel trading activities did not.

62. Thus, the data show that PIMCO trading Granger caused the artificiality in the June, 2005 Ten Year Treasury futures contract. Moreover, there is strong evidence of contemporaneous correlation between PIMCO's CTD and futures position changes and changes in artificiality. Other variables—changes in PIMCO's lending of the CTD and those measuring Citadel's activities—are not statistically significant.

63. Although during his deposition Dr. Hanke disavowed offering any opinion on whether Citadel's actions caused an artificial price, his report suggests this possibility.[34] The foregoing analysis shows that this suggestion is not supported by Granger Causality analysis.

64. Dr. Hanke asserts that Granger Causality tests "tend to find causal relations *too frequently*."[35] Dr. Hanke's analysis is incorrect, and the results reported supra are not subject to the econometric problem—"spurious regression"—that he attributes to it.

65. The article by Granger and Newbold[36] that Dr. Hanke cites in support of his claim that Granger Causality regressions result in excessive rates of false positives is not about Granger Causality at all. The phrase appears nowhere in that paper. Nor is Granger's seminal paper on causality cited therein. The spurious regression problem analyzed by

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[34] Hanke report, at 39-40.
[35] Id., at 19. Emphasis in original.
[36] C. W. J. Granger and P. Newbold, Spurious Regressions in Econometrics, 2 J. Econometrics (1974) 111.

Granger and Newbold involves the regression of the contemporaneous values of one integrated time series on another, whereas Granger Causality tests involve the regression of a variable on lagged values of other regressors.[37] Thus, Dr. Hanke's assertion about false positives is completely unsupported by the academic research he cites.

66. Moreover, Granger-Newbold document that differencing the dependent and independent variables can eliminate the spurious regression problem; both Hanke and I run regressions in first differences, so the 76 percent false positive result that Dr. Hanke cites is not relevant to the regressions that he or I run because it is based on regressions of levels on levels. Finally, Granger-Newbold suggest that a regression is likely to be spurious when the R-squared statistic is larger than the Durbin-Watson statistic. This is not the case in any of the regressions I run, so there is no evidence that my Granger Causality tests, or the regressions involving unlagged regressors, are spurious.

67. Hanke admits that "economic principles" and "economic logic" can be used to establish causation.[38] I employed economic principles—vetted in peer review academic research on manipulation—to establish causation in this case.

68. There is one analysis in which Dr. Hanke uses artificiality as a dependent variable. Specifically, he regresses the *level* of artificiality on contemporaneous PIMCO trading. He finds a negative coefficient, meaning that Dr. Hanke documents that PIMCO bought at low levels of artificiality, and sold at high levels of artificiality. He interprets this as

[37] Dr. Hanke also erroneously states that Granger and Newbold study cointegrated time series. Hanke report, at 19. A regression involving two or more integrated time series is not spurious if they are cointegrated; indeed, that is the defining characteristic of cointegrated time series. The first academic work on cointegrated time series did not appear until 1983—nine years after the Granger-Newbold paper.

[38] Hanke deposition, at 237-238. Dr. Hanke also admits that he has never employed Granger Causality in any of his writings, despite the fact that he frequently opined on causal relations therein. Id., at 76-77.

meaning that "if anything, PIMCO's trading mitigated artificiality."[39] This analysis actually shows the exact opposite.

69. I first note that it is peculiar to regress a level of one variable against a change in other variables. Conventional specifications regress changes on changes, or levels on levels.

70. Second, Dr. Hanke's result is perfectly consistent with a successful manipulation. A successful manipulator buys low and sells high. That is, the manipulator buys at low levels or artificiality, sells at high levels, and profits from the difference. Only failed—or suicidal—manipulators buy high and sell low. Thus, successful manipulation should exhibit a negative correlation between the level of artificiality and the alleged manipulator's trading. This is exactly what Dr. Hanke finds. Hence, Dr. Hanke's findings are exactly what one would expect during a manipulation.

71. There are also critical data and conceptual errors in Dr. Hanke's analysis.

72. With respect to data errors, his "Net Position (All)" and "Net Cash" figures (reported in Exhibit J, and used as an input for the calculation presented in Exhibits D1-D3 and H1-H3) are wrong. "Net Cash" is defined as the difference between the face value of PIMCO's position in the February 2012 note and PIMCO's net repo position. In calculating the net repo position, Dr. Hanke double counts; he counts a note as on repo on the end date of the repo transaction (i.e., the date on which the repo agreement matures and the note is to be returned to PIMCO). He also counts a note out on repo on the beginning date of the repo transaction (i.e,. the date on which PIMCO was obligated to deliver the note to the repo counterparty). Thus, Dr. Hanke counts a note to be returned and relent on a given date (e.g, 3 June, 2005) twice. This is incorrect. An examination of Hanke Exhibit J reveals the spikes in net repos on certain dates. These

[39] Hanke report, at 38.

correspond to the end dates of large PIMCO repo transactions. Exhibit R8 presents data that correct for Dr. Hanke's error.

73. The upward spikes in the net repo correspond to downward spikes in Hanke's Net Cash variable, and PIMCO's Total Position (All) variable. Since these data are erroneous, the regressions that Hanke runs using these variables (set out in exhibits D1-D3 and H1-H3) are subject to an errors in variables problem. It is well known that errors-in-variables tend to bias the magnitude of coefficients towards zero, and inflate their standard errors, making them appear less statistically significant. This error-in-variables problem makes Dr. Hanke's regressions unreliable.

74. With respect to the conceptual error, Dr. Hanke's netting of repos against the face value of the February 2012 note position imposes a constraint, namely, that a one dollar increase in PIMCO's net repo position exactly offsets a one dollar increase in its February 2012 note position. This is a testable hypothesis, but Dr. Hanke does not test it. In essence, he is assuming a result—that repo lending of a security exactly offsets the effect of a purchase of that security—that should be proven.

75. Moreover, the conceptual basis for Dr. Hanke's hypothesis is dubious. As I noted in my original report, a firm that lends out a security on repo is still long that security; the firm has a contract to repurchase the security at a later date. This is a long position in the note. Hence, netting out repos from the cash market holding ignores this long position, and as a result Dr. Hanke's "Net Cash" position is a misleading measure of PIMCO's claim on the CTD note.

76. I have estimated a VAR on the system including the change in the futures price (DF) and DCTDPOSITION, DFPOSITION, and DREPO. My data on PIMCO's CTD and

repo positions are not affected by the Dr. Hanke's computational and conceptual errors. The relevant statistical output is presented in Exhibit R7.

77. Not surprisingly, the R-squared statistic in the DF equation is smaller than its counterpart in the corresponding artificiality change VAR; this reflects the lower power of the model with the change in the futures price as the dependent variable. However, the p-value in the appropriate Granger Causality test for DCTDPOSITION in the DF equation is .0547, indicating that one only barely fails to reject the null hypothesis of no Granger Causality at the 5 percent level, but one can reject it at the 10 percent level. Thus, despite the lower power of the analysis based on changes in futures prices, there is evidence that changes in PIMCO's CTD position Granger Caused changes in the June futures price. Dr. Hanke misses—or obscures—this connection through his data and conceptual errors.

78. In his analysis of causation, Dr. Hanke examines PIMCO's share of open interest to determine its market power, i.e., its power to cause an artificial price. As I have noted in my peer reviewed academic research, this comparison is irrelevant. The relevant comparison is the size of the alleged manipulator's position to deliverable supply, as this quantifies the ability of the manipulator to force inefficient deliveries and thereby cause relative prices to rise. I made this comparison in my report, and Dr. Hanke in no way rebuts it. His reliance on irrelevant comparisons and failure to examine relevant ones renders his opinions on causation unreliable.

79. Dr. Hanke's apparently asserts that structural conditions in the market—notably the large difference between the value of the first and second cheapest-to-deliver notes—caused the excessive richness of the June contract. Such conditions made a long market

power manipulation very profitable for PIMCO, but it was PIMCO's manipulative acts that caused the artificially high prices. Dr. Hanke denigrates this conclusion as "sophistical."[40] He further argues that since "the criterion of an increasing marginal cost of delivery is satisfied for every market, all of the time, the apparent step of demonstrating 'potential artificiality' before 'artificiality' is bogus economics."[41]

80. It is Dr. Hanke's analysis that is "sophistical" and "bogus," and which reveals an ignorance of the economic literature on the subject of manipulation. In my peer reviewed academic writing on manipulation I have shown that the susceptibility of a market to manipulation is greater, the steeper the increase in the marginal cost of delivery for a given increase in the number of deliveries.[42] That is, it is not the mere fact that the marginal cost of delivery curve slopes upwards that is relevant; what is important is how steeply it slopes. The conditions identified by Dr. Hanke imply that the upward slope was unusually steep in May-June, 2005. Therefore, my published research (and economic common sense) show that the June contract was unduly susceptible to manipulation by a large long, i.e., PIMCO.

81. In his discussion of causation, Dr. Hanke avers that Dr. Merrick and I "assume implicitly that there is no price discovery in futures markets, or at least that holders of large long positions do not participate in it."[43] Dr. Hanke's assertion is incorrect: I make no such assumption. I note that, during the class period, the PIMCO emails discussing the valuation of the June futures contract did not address fundamentals (e.g., monetary policy), but instead focused on technical factors, specifically the likelihood of receiving

[40] Id., at 59.
[41] Id., at 60.
[42] Stephen Craig Pirrong, Manipulation of the Commodity Futures Market Delivery Process, 66 J. of Bus. (1993), at 349.
[43] Hanke report., at 21.

the second CTD and how PIMCO actions could affect that likelihood. Hence, their trading was not motivated by a different view on fundamentals (of the type that would contribute to price discovery). Moreover, PIMCO's standard valuation methodologies implied that the June futures price was extremely rich. Therefore, if PIMCO had been trading according to fundamental investment objectives and its standard relative valuation strategy, it would have continued selling additional June futures (and the CTD) to capture that richness. Therefore, in my opinion, PIMCO's trading was not driven by its different view of fundamentals. Rather, PIMCO acted as a price maker with an eye on "extract[ing] the maximum value"[44] from its large position through the exercise of market power.

82. Dr. Hanke also asserts that I ignore the fact that some futures shorts own the deliverable security when analyzing causation.[45] In doing so, Dr. Hanke ignores basic economics. It is a fundamental tenet of economics that prices are determined at the margin by the cost of the marginal seller and the willingness to pay of the marginal buyer. Even if shorts who own the security have lower costs to make delivery, if the marginal short (who does not own the security) incurs a higher cost, it is that trader's cost that determines the market clearing price. That is, Dr. Hanke's assertion about inframarginal traders is a red herring, as it is marginal shorts who determine the market clearing price.

83. Dr. Hanke asserts that Dr. Merrick and I "banish risk from their conception of the Treasury futures market."[46] In particular, he asserts that by assuming the cost of carry model holds, Dr. Merrick and I ignore basis risk. This is an ignorant statement. The basis can vary unpredictably in the cost-of-carry model due to variations in carrying

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[44] Pl. Ex. 9.
[45] Hanke report, at 24.
[46] Id., at 22.

costs. Moreover, we recognize that delivery options can have value, and variations in these option values can cause unpredictable variations in the basis—i.e., basis risk.[47]

84. Dr. Hanke's characterization of my (and Dr. Merrick's) analysis of causation as the "rumor theory" is misleading and tendentious.

IV. MANIPULATIVE ACTS & INTENT

85. Dr. Hanke claims that there is no evidence that PIMCO suffered losses due to "burying the corpse [body]."[48] Dr. Hanke's analysis is flawed, incomplete, and unreliable.

86. Dr. Hanke focuses on only one aspect of PIMCO's disposal of its roughly $18 billion position in the CTD note—the two tick spread charged by Goldman Sachs. He does not rebut the analysis in my report that this spread was very large compared to alternatives available to PIMCO. Thus, he does not rebut my contention that PIMCO incurred excessive transactions costs by taking delivery of the February, 2012 note, rather than liquidating its futures position, or switching into other, more liquid instruments (e.g., on-the-run Treasuries.)

87. More seriously, although Dr. Hanke mentions the concept of the "prevailing market price"[49] in his analysis of PIMCO's post-delivery actions, he nowhere analyzes what happened to this market price. This is a serious omission because the entire concept

[47] Dr. Hanke also mischaracterizes my book. He states that for manipulation to occur in the model in my book that incorporates risk, "the manipulator has to have better information about supply and demand conditions prevailing at delivery than other traders in the market." Id., at note 45. In fact, to make the model tractable, and to show that an information advantage is not a necessary condition for manipulation, I assume the exact opposite: "For simplicity, assume that all parties have access to the same information about θ as of t." Pirrong Market Power Manipulation, supra note 31, at 93. θ is the mathematical notation for supply and demand factors.

[48] Hanke report, at 52-53. I note that market participants commonly use the term "the corpse" to refer to the deliverables purchased during the consummation of a manipulation. Indeed, Judge Easterbrook has used this term. Frank Easterbrook, Monopoly, Manipulation, and the Regulation of Futures Markets, 59 J. of Bus. (1986), at S111.

[49] Hanke report, at 53.

of burying the corpse is that the manipulator incurs a loss when he sells what is delivered to him because the prevailing market price declines post-delivery. That is, a manipulator's losses from burying the corpse occur because the "prevailing market price" of the deliverable declines when the manipulator sells what is delivered to him.[50] No analysis of burying the corpse is complete without an examination of the prevailing market price when the manipulator liquidates; Dr. Hanke's analysis is therefore incomplete, because he fails to perform such an examination. Because it is incomplete, it is unreliable.

88. In fact, there is evidence on the record that the prevailing market price of the February, 2012 note declined substantially relative to comparable instruments when PIMCO ended its repo squeeze and began to sell the note in early-to-mid August, 2005. On 11 August, 2005, Mr. Keller informed Mr. Gross that while PIMCO was liquidating, the yield on the February, 2012 note had risen 5 basis points relative to the yields of the on-the-run Treasury (as measured by a butterfly spread). Since the DV01 of this note was about 6 cents, this translates into a loss of approximately $.30 per $100 of face amount, or a loss of approximately $54 million on PIMCO's $18 billion position.

89. Based on yields reported in the CRSP Treasury Bond data base, I have verified that from 1 August, 2005 through 16 August, 2005, the period in which PIMCO's liquidations were concentrated, the yield on the February, 2012 note rose by about

[50] For an analysis of this issue, see Pirrong, Market Power Manipulation, supra note 31, at Chapter 2; Pirrong, Detecting Manipulation, supra note 31, at 35. Easterbrook, supra note 48, at S107 also notes that a manipulator "must unload the commodity at a loss. He seeks to make more by jacking up the price of the futures contract than he loses on the cash commodity."

3.77 basis points relative to comparable off-the-run securities (the August, 2001 and August, 2013 Treasury Notes).

90. Hence, PIMCO did indeed suffer a substantial loss from "burying the corpse." This contradicts Dr. Hanke's claim. A claim, I repeat, that is based on an analysis that studiously avoids examining the crucial issue—the movements in the prevailing market price during the period of PIMCO's liquidation.

91. Dr. Hanke's assertions about my analysis of "excessive deliveries" is incomplete, seriously mischaracterizes my position, and is misleading.[51] Whereas Dr. Hanke states that my analysis of "excessive deliveries" uses only two metrics—the size of deliveries compared to historical deliveries, and whether a more expensive instrument was delivered—in fact my analysis both in my report and in my peer reviewed research focuses on a completely different metric: whether the deliveries taken were economically reasonable for a competitive, price taking trader. Paragraphs 60-70 of my report show in detail that (a) PIMCO took delivery against futures when the futures price exceeded the market price of the CTD, (b) that PIMCO was completely aware of this richness, and (c) the CBOT Business Conduct Committee warned PIMCO that taking delivery under these circumstances was problematic.

92. No competitive, price taking trader stands for deliveries when the cost of taking ownership of a security via delivery exceeds the market price of that security. A manipulator must do this. Thus, any deliveries taken under these conditions are not commercially reasonable, would not be taken by a competitive, non-manipulating trader, and hence are excessive and manipulative.[52] The fact that these deliveries

[51] Hanke report, at 28-30, 32-35.
[52] Pirrong, Detecting Manipulation, supra note 31, at 37, 50-52, 62-67.

were also extraordinary by historical standards certainly raises suspicions, but it is the taking of deliveries when the futures price exceeds the price of the CTD that provides the decisive evidence that these deliveries are excessive.[53]

93. Dr. Hanke nowhere rebuts my analysis showing that PIMCO took deliveries when market prices made it uneconomic for a competitive trader to do so; indeed, he does not even attempt such a rebuttal Hence, his analysis of whether deliveries against the June, 2005 Treasury Note futures contract were excessive is incomplete and unreliable.

94. Dr. Hanke does claim that traders sometimes take large deliveries pursuant to an arbitrage strategy. He does not attempt to show that this was a reasonable explanation for PIMCO's conduct—nor can he. Standing for delivery pursuant to an arbitrage strategy makes sense only when the futures price is below the spot price of the deliverable. As the CBOT repeatedly warned PIMCO, the price conditions prevailing in June, 2005 were the exact opposite of this.

95. Making delivery when the futures price exceeds the spot price can be an arbitrage strategy, but it would imply the firm standing for delivery is the *source* of arbitrage profits. This firm would rather attempt sell the overpriced futures than stand for delivery. Even if the short continues to hold its position, a competitive long should be willing to bid down the futures price until it equals the spot price of the deliverable, at which point both the short and the long are indifferent between liquidating their positions, or closing them by delivery.[54]

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[53] The fact that the CBT subsequently limited a firm to taking 50,000 deliveries against T-note futures clearly suggests that the exchange also considered the 132,000 deliveries PIMCO took as excessive.

[54] This analysis bears on Dr. Hanke's bizarre notion that since shorts have the option to deliver, longs play a purely passive role in the delivery process. Hanke deposition, at 198. Longs need not be passive. If

96. Hence, a firm like PIMCO that willingly stands for delivery against overpriced futures is almost certainly doing so pursuant to a manipulative strategy.

97. Relatedly, Dr. Hanke testified that convergence occurred in the June, 2005 futures contract[55]; the term convergence refers to the process whereby the futures price comes to equal the spot price of the deliverable at the end of trading of the futures contract. Due to convergence, the net basis at the end of trading should equal zero.

98. Convergence demonstrably did not occur in June, 2005. The net basis at the end of trading of the June, 2005 Treasury Note futures contract was negative by more than 8 32ds on 21 June, 2005.

99. Dr. Hanke opines that PIMCO had "an economic reason for not rolling" its June futures position into September.[56] Dr. Hanke acknowledges that rolling into September would have imposed losses on PIMCO only if the richness in the September contract had diminished over the remaining life of that contract.[57] He merely asserts, however, that the September contract "was likely to cheapen as the August 2012 note reverted to its predicted value."[58] He provides no evidence or argument whatsoever that such a reversion would occur—or whether it did in fact occur. Absent evidence and reasonable supporting argument, Dr. Hanke's opinion is unreliable.

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futures are overpriced, they can attempt to sell futures. Shorts are unlikely to want to purchase the overpriced futures, but the resulting selling pressure will drive down the futures price until the short and the long can find a mutually agreeable price at which to liquidate. A competitive long should be willing to sell futures as long as the futures price exceeds the spot price of the deliverable. A long that passively stands for delivery—and indeed increases its long futures position when futures are overpriced relative to the CTD—is either unbelievably stupid, or attempting to manipulate the market. It is reasonable to rule out the possibility that the managers of the world's largest bond fund were stupid in June, 2005, leaving manipulation as the only remaining explanation of their actions.

[55] Id., at 201. Dr. Hanke's assumes this conclusion, rather than prove it by reference to any data: "I believe there was convergence. There is always convergence in futures markets, so."

[56] Hanke report, at 42.

[57] Id., at 43.

[58] Id., at 44.

100. Dr. Hanke's opinion about "reversion . . . to predicted value" flatly contradicts PIMCO's Mr. Zhu's belief that the Treasury Note futures contract was likely to stay rich for three quarters. Moreover, this opinion is inconsistent with Dr. Hanke's explanation of the richness of the June futures contract, which he attributes to structural factors such as large open interest and small deliverable supply. Both of these conditions characterized the September contract as well, and if Dr. Hanke were logically consistent he would conclude that the richness in the September would not be likely to disappear as long as these structural conditions persisted. Indeed, Dr. Hanke claims that "PIMCO felt the September 2005 future was overpriced due to supply constraints pertaining to the August 2012 note."[59] Unless Dr. Hanke disagrees with PIMCO's analysis, or believes that somehow these supply constraints were going to disappear, his conclusion that the September would cheapen is inconsistent with the rest of his analysis. Moreover, Dr. Hanke's "analysis" begs the question of how the September contract could remain so rich for so long in an efficient financial market if it were merely a transitory mispricing. Dr. Hanke also fails to note that the September contract remained rich until that contract expired—a fact that is consistent with Mr. Zhu's analysis, but which flatly contradicts Dr. Hanke's blithe assertion.

101. Dr. Hanke also attempts to argue that the fact that PIMCO took huge deliveries against futures when no one else did does not imply that PIMCO had no competitive economic rationale for its decision.[60] To support this assertion, Dr. Hanke states that "many traders lack the cash to take delivery. So even though PIMCO could entertain taking delivery, other cash-constrained accounts could find rolling superior to taking

[59] Id., at 44.
[60] Id., at 42.

delivery."[61] Does Dr. Hanke seriously believe that no one else in the market had the cash to take delivery if the economics had justified it? Although PIMCO was the world's largest real money bond fund, it was not the only one. Moreover, if Defendants' representations about Citadel taking huge deliveries against the March contract are correct, even non-real money hedge funds can scrape up the cash to take deliveries. Indeed, Dr. Hanke emphasizes the large deliveries taken against the March 2005 contract.[62] Since PIMCO took none of these deliveries, apparently somebody else was able to gather the necessary cash. Hence, in my opinion the failure of anyone other than PIMCO to take deliveries in large quantity against the June contract provides strong evidence that it was uneconomic to take deliveries given the prevailing price structure, and hence PIMCO's taking of deliveries was manipulative.

102. Dr. Hanke also examines only one of the liquidation alternatives available to PIMCO; the roll into September. He does not rebut my analysis that shows that per PIMCO's own data and valuation methodologies, it could have profitably liquidated its rich June futures and purchased larger quantities of cheaper instruments, including on-the-run Treasuries and swaps. Thus, Dr. Hanke's analysis is incomplete and unreliable.

103. Dr. Hanke claims that a lack of liquidity impaired PIMCO's ability to move out of the June contract.[63] First, the fact is (as emphasized in my report) that low liquidity (specifically, low market depth) is an expected consequence of manipulation. Second, Dr. Hanke relies on grossly understated volume information as a basis for his

[61] Id., at 42-43.
[62] Id., at 36.
[63] Id., at 45.

opinion. Specifically, the volume figures cited on page 46 and Exhibit A of his report are for floor trading volume only, and omit the largest source of trading volume—electronic trading. For instance, Dr. Hanke claims that average daily volume of the June contract during the month of June averaged 7,100 contracts per day, when in fact, trading averaged 48,332 contracts per day—almost seven times what Dr. Hanke asserts.

104. I attach a revised version of Hanke's Exhibit A including the correct volume figures as Exhibit R9.

105. Because Dr. Hanke uses incorrect volume data, his conclusions based thereon (specifically those on page 46 of his report) are unreliable.

<u>V. DAMAGES CALCULATION</u>

106. Dr. Hanke's critique of my damages calculation is completely misguided. The possibility that some shorts sold at a higher artificiality than they purchased is readily addressed once proofs of claim are received. Although the damages methodology has not been established, if the Court decides that those who sell at higher artificiality than they buy are not to receive compensation, Dr. Hanke's criticisms become moot.

107. More specifically, Dr. Hanke's inability to fathom how the damage calculation presented in my report is "conservative"[64] reflects a more fundamental misunderstanding of that calculation. A simple example illustrates why the calculation is, in fact, conservative.

108. The $632 million damage number in my report assumes that shorts established positions at zero artificiality, and calculates damages on a given day by multiplying the change in open interest on a given day (if negative) by the artificiality on that day.

[64] Id., at 65.

This methodology actually understates the damages suffered by some shorts, and incorporates an offset to reflect the possibility that some parties sold at higher artificiality than they purchased. In my opinion, PIMCO should not be rewarded for the damages it caused because some third party received a windfall, so my calculation understates the amount of compensation that PIMCO owes damaged shorts.

109. The scenario is simple, but capture the essence of the facts of this case, and is directly responsive to Dr. Hanke's analysis. In each scenario, ten shorts—S1-S10—sell 1 contract each at zero artificiality on day 0. Five longs—L1-L5—buy one contract each, and a manipulator—M—buys 5 contracts.

110. In this scenario, there are 2 units of artificiality on day 1, and 1 unit of artificiality on day 2.

111. In the scenario, S1-S10 buy their futures on day 1, L1-L5 sell their futures, and a new trader, X, sells 5 contracts. Thus, open interest falls by 5.

112. On day 2, X buys back 5 contracts, and realizes a gain of 5 because it sold 5 contracts at 2 units of artificiality and bought back these contracts at 1 unit of artificiality. Open interest falls by 5 units on day 2.

113. My damage calculation methodology would show total damages of 15: 5 contracts liquidated on day 1 at 2 units of artificiality, and 5 contracts liquidated on day 2 at 1 unit of artificiality. In fact, shorts S1-S10 suffered damage of 20 because they bought back 10 contracts at 2 units of artificiality each. The difference between the 20 in actual damages that shorts suffered, and the 15 produced by my calculation, reflects the gain of 5 realized by trader X—who would be analogous to the Millennium Futures LP or Barclay Capital Futures examples raised in Dr. Hanke's

report. Thus, although in my opinion that PIMCO should not be rewarded for losses suffered by shorts that are captured by third parties, my analysis is conservative because it incorporates such a reward. That is, it not only rewards zero damage to trader X, it actually deducts trader X's gain against the damages suffered by S1-S10. This is conservative.

114. Dr. Hanke makes other basic errors in his analysis of my damages methodology. Specifically, he asserts that "one must consider traders' entire portfolios to estimate damages."[65] He also claims that I "ignored traders' positions in other interest rate instruments."[66] Both statements reflect a complete misunderstanding of the method for calculating artificiality, and my application thereof to the calculation of damages.

115. Recall from my analysis in section III supra that my artificiality calculation is based on a change in the price of the June futures *relative* to the prices of other instruments. That is, it reflects the change in the price of the June futures over and above any change in the comparable instruments. Thus, even if a trader were long other interest rate instruments (e.g., mortgages, or on-the-run Treasuries), the damage calculation would take this into account as it would estimate damages based only on the price movement of the June futures over and above the movement of the comparable instruments. If the manipulation caused the price of these other instruments to increase (an arguable proposition), the true total artificiality would be the artificiality I estimated *plus* the increase in the price of the other instruments. However, my artificiality estimate does not include this putative price increase of the comparables. This increase would increase the amount of futures damages, but would

[65] Id., at 64.
[66] Id., at 65.

be offset by an increase in the value of the hypothetical hedger's portfolio. Hence, contrary to Dr. Hanke's unsupported assertion, this effect nets out for a hypothetical hedger.[67]

116. Indeed, this points out another element of conservatism in my methodology. If Dr. Hanke is correct that a manipulation increases the price of other instruments because "changes in one interest rate instrument can affect other interest rate instruments,"[68] then my estimates of futures artificiality are an *underestimate* of true artificiality because I assume no such effect. This ensures that those short futures as a hedge of comparable securities are not overcompensated for the futures price rise, but it underestimates damages suffered by those who were short futures but had *no* position in "other interest rate instruments" because my relative price-based artificiality estimates assume no collateral inflation of the other interest rate instruments used to calculate relative prices.[69]

117. Thus, these hedging-related criticisms of my damage calculation are completely baseless and misleading, and reflect Dr. Hanke's failure to grasp the implications of using relative price distortions as a measure of artificiality.

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[67] The only security for which a hedging offset is remotely reasonable is the CTD note. However, even for this note Dr. Hanke's argument lacks any significance. First, to the extent that shorts owned the note and delivered it against futures, they would not be in the class. Since the entire float of the CTD note was delivered, and since large amounts of the CTD note were "in the box" throughout the class period, in my opinion it is highly likely that most owners of the CTD note would not be in the class. Second, my damages calculation methodology attributes damages only on days when open interest declines. Since holders of the note who delivered do not liquidate their positions, their trading could not cause a decrease in open interest, and hence their trades would not be incorporated in the damages estimate. Third, the futures price rose relative to the price of the CTD, imposing a loss on those long the basis. Dr. Hanke makes the bizarre statement that those long the basis profited from the manipulation. Id., at 64. The basis weakened during the class period, meaning that those that were long the basis lost money on basis positions carried into the class period. Fourth, during the claims administration process it is possible to take into account a hedging offset for those long the CTD note. These parties were damaged only to the extent that the net basis moved against them, but data on the net basis can be used to calculate their damages.

[68] Id., at 64.

[69] Related issues are discussed in Pirrong Detecting Manipulation, supra note 31, at 42.

Dr. Craig Pirrong

Dr. Craig Pirrong

21 May, 2007

21 May, 2007

Exhibit R1

20050509	0.10129	0.0610
20050510	0.18193	0.0037
20050511	0.2373	0.0002
20050512	0.25713	0.0001
20050513	0.23543	0.0002
20050516	0.20581	0.0015
20050517	0.18155	0.0045
20050518	0.2876	0.0000
20050519	0.33651	0.0000
20050520	0.51169	0.0000
20050523	0.51501	0.0000
20050524	0.78694	0.0000
20050525	0.755	0.0000
20050526	0.56644	0.0000
20050527	0.60438	0.0000
20050531	0.32274	0.0000
20050601	0.28406	0.0001
20050602	0.3292	0.0000
20050603	0.29287	0.0000
20050606	0.29936	0.0001
20050607	0.40102	0.0000
20050608	0.42886	0.0000
20050609	0.3242	0.0000
20050610	0.28078	0.0000
20050613	0.20789	0.0013
20050614	0.17347	0.0045
20050615	0.16983	0.0042
20050616	0.2392	0.0002
20050617	0.15471	0.0103
20050620	0.13486	0.0189
20050621	0.31883	0.0000

Exhibit R2

Dependent Variable: DFYART
Method: Least Squares
Date: 05/17/07 Time: 12:43
Sample (adjusted): 2 32
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007097	0.017009	0.417226	0.6798
DCTDPOSITION	1.87E-10	4.79E-11	3.899409	0.0006
DFPOSITION	1.96E-06	1.06E-06	1.859424	0.0739
DREPO	-2.07E-11	3.08E-11	-0.674372	0.5058

R-squared	0.361941	Mean dependent var	0.010020
Adjusted R-squared	0.291046	S.D. dependent var	0.102959
S.E. of regression	0.086691	Akaike info criterion	-1.933015
Sum squared resid	0.202915	Schwarz criterion	-1.747985
Log likelihood	33.96174	F-statistic	5.105289
Durbin-Watson stat	2.073229	Prob(F-statistic)	0.006291

Exhibit R3

Vector Autoregression Estimates

Vector Autoregression Estimates
Date: 05/17/07 Time: 12:46
Sample (adjusted): 4 32
Included observations: 29 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DFYART	DCTDPOSITI	DFPOSITION	DREPO
DFYART(-1)	-0.098676	1.81E+08	14238.16	-5.67E+08
	(0.19031)	(7.7E+08)	(45645.3)	(1.1E+09)
	[-0.51849]	[0.23640]	[0.31193]	[-0.49699]
DFYART(-2)	-0.345461	-6.97E+08	24556.19	5.08E+08
	(0.18961)	(7.6E+08)	(45477.1)	(1.1E+09)
	[-1.82193]	[-0.91174]	[0.53997]	[0.44696]
DCTDPOSITION(-1)	2.08E-10	0.651794	-2.59E-05	1.077737
	(7.0E-11)	(0.28411)	(1.7E-05)	(0.42252)
	[2.95674]	[2.29412]	[-1.53216]	[2.55072]
DCTDPOSITION(-2)	6.25E-11	0.036914	-7.65E-06	-0.266572
	(6.6E-11)	(0.26487)	(1.6E-05)	(0.39390)
	[0.95096]	[0.13937]	[-0.48535]	[-0.67675]
DFPOSITION(-1)	3.30E-07	-5150.504	-0.062100	4865.383
	(1.2E-06)	(4649.76)	(0.27661)	(6914.93)
	[0.28602]	[-1.10769]	[-0.22450]	[0.70361]
DFPOSITION(-2)	4.76E-06	9177.973	-0.074680	-6862.590
	(1.1E-06)	(4405.83)	(0.26210)	(6552.17)
	[4.35654]	[2.08314]	[-0.28493]	[-1.04738]
DREPO(-1)	-2.96E-11	-0.060451	1.92E-06	0.031417
	(3.4E-11)	(0.13747)	(8.2E-06)	(0.20444)
	[-0.86863]	[-0.43974]	[0.23458]	[0.15368]
DREPO(-2)	6.68E-12	0.016919	-2.82E-06	0.068437
	(3.0E-11)	(0.12085)	(7.2E-06)	(0.17972)
	[0.22273]	[0.14000]	[-0.39231]	[0.38081]
C	0.025411	53039450	-5124.675	88995092
	(0.01730)	(7.0E+07)	(4149.56)	(1.0E+08)
	[1.46873]	[0.76039]	[-1.23499]	[0.85792]
R-squared	0.577148	0.515740	0.242428	0.472833
Adj. R-squared	0.408008	0.322036	-0.060601	0.261966
Sum sq. resids	0.128388	2.09E+18	7.39E+09	4.62E+18
S.E. equation	0.080121	3.23E+08	19216.48	4.80E+08
F-statistic	3.412240	2.662513	0.800016	2.242327
Log likelihood	37.44066	-603.9655	-321.8037	-615.4746
Akaike AIC	-1.961425	42.27348	22.81405	43.06722
Schwarz SC	-1.537092	42.69781	23.23838	43.49155
Mean dependent	0.006716	70422690	-7129.862	1.82E+08
S.D. dependent	0.104133	3.92E+08	18659.40	5.59E+08

Determinant resid covariance (dof adj.)	2.73E+40
Determinant resid covariance	6.17E+39
Log likelihood	-1493.106
Akaike information criterion	105.4556
Schwarz criterion	107.1529

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 05/17/07 Time: 12:47
Sample: 1 32
Included observations: 29

Dependent variable: DFYART

Excluded	Chi-sq	df	Prob.
DCTDPOSITI	9.920623	2	0.0070
DFPOSITION	19.03465	2	0.0001
DREPO	0.772943	2	0.6795
All	25.97461	6	0.0002

Dependent variable: DCTDPOSITION

Excluded	Chi-sq	df	Prob.
DFYART	0.943264	2	0.6240
DFPOSITION	6.204773	2	0.0449
DREPO	0.202609	2	0.9037
All	6.525239	6	0.3670

Dependent variable: DFPOSITION

Excluded	Chi-sq	df	Prob.
DFYART	0.357252	2	0.8364
DCTDPOSITI	2.655615	2	0.2651
DREPO	0.192315	2	0.9083
All	3.358435	6	0.7627

Dependent variable: DREPO

Excluded	Chi-sq	df	Prob.
DFYART	0.499314	2	0.7791
DCTDPOSITI	6.822236	2	0.0330
DFPOSITION	1.793238	2	0.4079
All	15.51455	6	0.0166

Exhibit R4

Dependent Variable: DFYART
Method: Least Squares
Date: 05/17/07 Time: 12:38
Sample (adjusted): 4 32
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.031319	0.018799	1.665969	0.1140
DCTDPOSITION	9.95E-11	7.65E-11	1.300230	0.2109
DCTDPOSITION(-1)	2.15E-10	8.92E-11	2.410004	0.0276
DCTDPOSITION(-2)	6.60E-11	6.81E-11	0.969603	0.3458
DFPOSITION	1.77E-06	1.28E-06	1.385862	0.1837
DFPOSITION(-1)	1.07E-06	1.30E-06	0.822828	0.4220
DFPOSITION(-2)	3.82E-06	1.36E-06	2.816092	0.0119
DREPO	-2.37E-11	4.03E-11	-0.588684	0.5638
DREPO(-1)	-2.63E-11	3.50E-11	-0.749560	0.4638
DREPO(-2)	1.16E-11	3.09E-11	0.375562	0.7119
DFYART(-1)	-0.155377	0.198862	-0.781330	0.4454
DFYART(-2)	-0.307571	0.199476	-1.541899	0.1415

R-squared	0.625527	Mean dependent var	0.006716
Adjusted R-squared	0.383220	S.D. dependent var	0.104133
S.E. of regression	0.081781	Akaike info criterion	-1.876029
Sum squared resid	0.113700	Schwarz criterion	-1.310251
Log likelihood	39.20242	F-statistic	2.581553
Durbin-Watson stat	2.062381	Prob(F-statistic)	0.038522

Redundant Variables: DCTDPOSITION(0 TO -2)

F-statistic	3.377691	Probability	0.042677
Log likelihood ratio	13.55866	Probability	0.003572

Test Equation:
Dependent Variable: DFYART
Method: Least Squares
Date: 05/17/07 Time: 12:49
Sample: 4 32
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012524	0.020746	0.603686	0.5528
DFPOSITION	-3.18E-07	1.04E-06	-0.304540	0.7639
DFPOSITION(-1)	-1.74E-06	1.08E-06	-1.606056	0.1239
DFPOSITION(-2)	3.71E-06	1.16E-06	3.194985	0.0045
DREPO	3.91E-11	3.83E-11	1.020331	0.3198
DREPO(-1)	-5.66E-14	3.61E-11	-0.001567	0.9988
DREPO(-2)	-2.77E-12	3.44E-11	-0.080624	0.9365
DFYART(-1)	0.198075	0.191126	1.036360	0.3124
DFYART(-2)	-0.164935	0.183455	-0.899051	0.3793

R-squared	0.402317	Mean dependent var	0.006716
Adjusted R-squared	0.163244	S.D. dependent var	0.104133
S.E. of regression	0.095255	Akaike info criterion	-1.615385
Sum squared resid	0.181472	Schwarz criterion	-1.191052
Log likelihood	32.42308	F-statistic	1.682818
Durbin-Watson stat	2.182487	Prob(F-statistic)	0.164343

Redundant Variables: DFPOSITION(0 TO -2)

F-statistic	4.768507	Probability	0.013698
Log likelihood ratio	17.70685	Probability	0.000506

Test Equation:
Dependent Variable: DFYART
Method: Least Squares
Date: 05/17/07 Time: 12:49
Sample: 4 32
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007678	0.021360	0.359449	0.7230
DCTDPOSITION	1.10E-10	6.19E-11	1.773104	0.0914
DCTDPOSITION(-1)	9.13E-11	9.23E-11	0.989473	0.3343
DCTDPOSITION(-2)	-4.87E-11	7.57E-11	-0.643047	0.5275
DREPO	-4.03E-11	4.56E-11	-0.883901	0.3873
DREPO(-1)	-1.31E-11	4.34E-11	-0.301093	0.7665
DREPO(-2)	-3.98E-12	3.78E-11	-0.105299	0.9172
DFYART(-1)	-0.051529	0.227726	-0.226275	0.8233
DFYART(-2)	-0.028858	0.226561	-0.127376	0.8999

R-squared	0.310407	Mean dependent var	0.006716
Adjusted R-squared	0.034570	S.D. dependent var	0.104133
S.E. of regression	0.102318	Akaike info criterion	-1.472344
Sum squared resid	0.209378	Schwarz criterion	-1.048011
Log likelihood	30.34899	F-statistic	1.125326
Durbin-Watson stat	1.840483	Prob(F-statistic)	0.388684

Redundant Variables: DREPO(0 TO -2)

F-statistic	0.338696	Probability	0.797604
Log likelihood ratio	1.683501	Probability	0.640608

Test Equation:
Dependent Variable: DFYART
Method: Least Squares
Date: 05/17/07 Time: 12:50
Sample: 4 32
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.026688	0.016913	1.577922	0.1303
DCTDPOSITION	8.98E-11	6.88E-11	1.304669	0.2068
DCTDPOSITION(-1)	1.77E-10	7.42E-11	2.389364	0.0268
DCTDPOSITION(-2)	5.28E-11	5.63E-11	0.938138	0.3594
DFPOSITION	1.54E-06	1.16E-06	1.332142	0.1978
DFPOSITION(-1)	7.37E-07	1.17E-06	0.629799	0.5360
DFPOSITION(-2)	3.98E-06	1.20E-06	3.311040	0.0035
DFYART(-1)	-0.115035	0.183466	-0.627008	0.5377
DFYART(-2)	-0.308838	0.185236	-1.667265	0.1110

R-squared	0.603144	Mean dependent var	0.006716
Adjusted R-squared	0.444402	S.D. dependent var	0.104133
S.E. of regression	0.077619	Akaike info criterion	-2.024873
Sum squared resid	0.120495	Schwarz criterion	-1.600540
Log likelihood	38.36066	F-statistic	3.799520
Durbin-Watson stat	2.061330	Prob(F-statistic)	0.007298

Exhibit R5

Dependent Variable: DFYART
Method: Least Squares
Date: 05/17/07 Time: 12:51
Sample (adjusted): 2 31
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001640	0.024372	0.067283	0.9469
DCTDPOSITION	1.66E-10	5.14E-11	3.222797	0.0036
DFPOSITION	1.71E-06	1.27E-06	1.348949	0.1899
DCITADELCTDPOS	1.07E-07	1.28E-07	0.835978	0.4114
DCITADELFPOS	5.29E-07	7.00E-06	0.075614	0.9404
DCITADELNOLEND	4.44E-09	2.99E-08	0.148672	0.8831

R-squared	0.398040	Mean dependent var	0.005825
Adjusted R-squared	0.272632	S.D. dependent var	0.101990
S.E. of regression	0.086983	Akaike info criterion	-1.869357
Sum squared resid	0.181584	Schwarz criterion	-1.589117
Log likelihood	34.04035	F-statistic	3.173957
Durbin-Watson stat	2.063735	Prob(F-statistic)	0.024398

Exhibit R6

Vector Autoregression Estimates

Vector Autoregression Estimates
Date: 05/11/07 Time: 20:22
Sample (adjusted): 4 31
Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DFYART	DCTDPOSITI	DFPOSITION	DCITADELCT	DCITADELFP	DCITADELNO
DFYART(-1)	-0.076187	2.43E+08	6385.223	-277858.6	8892.160	510653.6
	(0.19530)	(6.0E+08)	(36756.4)	(324937.)	(5815.80)	(1225752)
	[-0.39011]	[0.40419]	[0.17372]	[-0.85512]	[1.52897]	[0.41660]
DFYART(-2)	-0.410519	-6.09E+08	16679.10	-589778.4	11921.68	-798920.5
	(0.22389)	(6.9E+08)	(42137.4)	(372506.)	(6667.21)	(1405198)
	[-1.83359]	[-0.88394]	[0.39583]	[-1.58327]	[1.78811]	[-0.56855]
DCTDPOSITION(-1)	2.43E-10	0.114077	7.37E-06	0.000204	-6.58E-06	0.000438
	(9.8E-11)	(0.30123)	(1.8E-05)	(0.00016)	(2.9E-06)	(0.00061)
	[2.48857]	[0.37870]	[0.40008]	[1.25486]	[-2.25833]	[0.71322]
DCTDPOSITION(-2)	5.85E-11	-0.084259	-2.36E-06	-4.80E-06	-4.05E-06	0.000195
	(6.7E-11)	(0.20682)	(1.3E-05)	(0.00011)	(2.0E-06)	(0.00042)
	[0.87105]	[-0.40741]	[-0.18686]	[-0.04294]	[-2.02350]	[0.46358]
DFPOSITION(-1)	-2.29E-07	-7875.328	-0.085553	-0.578505	-0.042161	-2.017383
	(1.4E-06)	(4231.97)	(0.25871)	(2.28706)	(0.04093)	(8.62743)
	[-0.16657]	[-1.86091]	[-0.33069]	[-0.25295]	[-1.02998]	[-0.23383]
DFPOSITION(-2)	4.53E-06	45.40574	0.524822	-1.929808	-0.117391	6.411890
	(1.6E-06)	(4816.41)	(0.29444)	(2.60291)	(0.04659)	(9.81889)
	[2.89760]	[0.00943]	[1.78246]	[-0.74141]	[-2.51980]	[0.65302]
DCITADELCTDPOS(-1)	-2.14E-07	187.8650	-0.003922	-0.109085	0.000908	-0.710067
	(1.4E-07)	(441.938)	(0.02702)	(0.23883)	(0.00427)	(0.90095)
	[-1.49292]	[0.42509]	[-0.14516]	[-0.45674]	[0.21239]	[-0.78813]
DCITADELCTDPOS(-2)	6.71E-08	54.78086	-0.004873	-0.031208	0.000776	0.897293
	(1.3E-07)	(409.643)	(0.02504)	(0.22138)	(0.00396)	(0.83511)
	[0.50411]	[0.13373]	[-0.19461]	[-0.14097]	[0.19595]	[1.07446]
DCITADELFPOS(-1)	2.51E-06	-4785.662	-0.124234	-16.46051	0.043132	52.39607
	(9.9E-06)	(30534.7)	(1.86665)	(16.5017)	(0.29535)	(62.2490)
	[0.25356]	[-0.15673]	[-0.06655]	[-0.99750]	[0.14604]	[0.84172]
DCITADELFPOS(-2)	-1.10E-05	9352.910	-0.624162	-16.03516	0.324965	-106.7314
	(9.0E-06)	(27713.8)	(1.69420)	(14.9772)	(0.26807)	(56.4982)
	[-1.22335]	[0.33748]	[-0.36841]	[-1.07064]	[1.21226]	[-1.88911]
DCITADELNOLEND(-1)	4.89E-08	61.59117	0.008293	0.038765	0.000142	0.924554
	(4.8E-08)	(149.317)	(0.00913)	(0.08069)	(0.00144)	(0.30440)
	[1.00734]	[0.41249]	[0.90854]	[0.48040]	[0.09823]	[3.03728]
DCITADELNOLEND(-2)	-3.96E-08	417.7023	-0.032094	0.007758	0.003376	-0.619709
	(6.5E-08)	(200.328)	(0.01225)	(0.10826)	(0.00194)	(0.40840)
	[-0.60840]	[2.08509]	[-2.62069]	[0.07166]	[1.74247]	[-1.51742]
C	-0.007229	-98504066	959.9852	-115173.3	-2222.074	79735.69
	(0.03181)	(9.8E+07)	(5987.41)	(52930.3)	(947.360)	(199668.)
	[-0.22724]	[-1.00574]	[0.16033]	[-2.17594]	[-2.34554]	[0.39934]
R-squared	0.657359	0.783252	0.638773	0.498546	0.580980	0.594606
Adj. R-squared	0.383247	0.609853	0.349791	0.097383	0.245765	0.270290
Sum sq. resids	0.098115	9.30E+17	3.48E+09	2.72E+11	87009117	3.87E+12
S.E. equation	0.080877	2.49E+08	15221.61	134563.2	2408.445	507610.0
F-statistic	2.398138	4.517056	2.210427	1.242752	1.733154	1.833418
Log likelihood	39.42313	-572.3146	-300.6453	-361.6662	-249.0207	-398.8412
Akaike AIC	-1.887366	41.80818	22.40324	26.76187	18.71577	29.41723
Schwarz SC	-1.268843	42.42671	23.02176	27.38040	19.33429	30.03576
Mean dependent	0.002104	75241357	-7526.250	-24140.54	-1537.679	239267.9
S.D. dependent	0.102983	3.99E+08	18877.06	141636.3	2773.214	594230.7

Vector Autoregression Estimates

Determinant resid covariance (dof adj.)	1.05E+50
Determinant resid covariance	2.49E+48
Log likelihood	-1798.478
Akaike information criterion	134.0342
Schwarz criterion	137.7453

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 05/17/07 Time: 12:53
Sample: 1 32
Included observations: 28

Dependent variable: DFYART

Excluded	Chi-sq	df	Prob.
DCTDPOSITI	6.263119	2	0.0436
DFPOSITION	9.000875	2	0.0111
DCITADELCT	2.458129	2	0.2926
DCITADELFP	1.628356	2	0.4430
DCITADELNO	1.110692	2	0.5739
All	27.75619	10	0.0020

Dependent variable: DCTDPOSITION

Excluded	Chi-sq	df	Prob.
DFYART	1.030966	2	0.5972
DFPOSITION	3.622825	2	0.1634
DCITADELCT	0.200572	2	0.9046
DCITADELFP	0.113898	2	0.9446
DCITADELNO	15.76042	2	0.0004
All	29.46810	10	0.0010

Dependent variable: DFPOSITION

Excluded	Chi-sq	df	Prob.
DFYART	0.174353	2	0.9165
DCTDPOSITI	0.246943	2	0.8838
DCITADELCT	0.059917	2	0.9705
DCITADELFP	0.209250	2	0.9007
DCITADELNO	10.51527	2	0.0052
All	21.92814	10	0.0155

Dependent variable: DCITADELCTDPOS

Excluded	Chi-sq	df	Prob.
DFYART	2.986896	2	0.2246
DCTDPOSITI	1.707176	2	0.4259
DFPOSITION	0.560292	2	0.7557
DCITADELFP	4.031433	2	0.1332
DCITADELNO	0.778481	2	0.6776
All	14.12796	10	0.1672

Dependent variable: DCITADELFPOS

Excluded	Chi-sq	df	Prob.
DFYART	5.016899	2	0.0814
DCTDPOSITI	7.388570	2	0.0249
DFPOSITION	6.624038	2	0.0364
DCITADELCT	0.084942	2	0.9584
DCITADELNO	8.890773	2	0.0117
All	15.66527	10	0.1096

Dependent variable: DCITADELNOLEND

Excluded	Chi-sq	df	Prob.
DFYART	0.552549	2	0.7586
DCTDPOSITI	0.596704	2	0.7420
DFPOSITION	0.567674	2	0.7529
DCITADELCT	1.747416	2	0.4174
DCITADELFP	3.571324	2	0.1677
All	6.744763	10	0.7493

Exhibit R7

Vector Autoregression Estimates

Vector Autoregression Estimates
Date: 05/18/07 Time: 10:12
Sample (adjusted): 4 32
Included observations: 29 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DF	DCTDPOSITI	DFPOSITION	DREPO
DF(-1)	0.063944	13615495	14257.78	71505498
	(0.20584)	(2.2E+08)	(12201.2)	(3.3E+08)
	[0.31065]	[0.06226]	[1.16856]	[0.21711]
DF(-2)	-0.420904	-2.13E+08	15772.58	35338986
	(0.19893)	(2.1E+08)	(11791.9)	(3.2E+08)
	[-2.11582]	[-1.00825]	[1.33758]	[0.11102]
DCTDPOSITION(-1)	5.75E-10	0.697164	-3.06E-05	0.950143
	(2.4E-10)	(0.25343)	(1.4E-05)	(0.38167)
	[2.41078]	[2.75088]	[-2.16436]	[2.48941]
DCTDPOSITION(-2)	-7.16E-11	-0.043290	-9.69E-06	-0.211441
	(2.2E-10)	(0.22912)	(1.3E-05)	(0.34505)
	[-0.33197]	[-0.18894]	[-0.75805]	[-0.61278]
DFPOSITION(-1)	3.10E-06	-4116.381	-0.126248	3610.188
	(4.2E-06)	(4466.75)	(0.24921)	(6727.00)
	[0.73658]	[-0.92156]	[-0.50659]	[0.53667]
DFPOSITION(-2)	6.42E-06	7944.178	-0.079304	-6273.723
	(3.9E-06)	(4177.16)	(0.23305)	(6290.87)
	[1.63335]	[1.90181]	[-0.34028]	[-0.99727]
DREPO(-1)	4.18E-12	-0.044312	6.41E-07	0.038795
	(1.3E-10)	(0.13511)	(7.5E-06)	(0.20347)
	[0.03285]	[-0.32798]	[0.08504]	[0.19066]
DREPO(-2)	8.51E-11	0.041804	-3.90E-06	0.066918
	(1.1E-10)	(0.12160)	(6.8E-06)	(0.18313)
	[0.74328]	[0.34379]	[-0.57476]	[0.36542]
C	0.067775	53722045	-5588.794	85208215
	(0.06566)	(7.0E+07)	(3891.91)	(1.1E+08)
	[1.03225]	[0.77013]	[-1.43600]	[0.81108]
R-squared	0.386553	0.517464	0.336033	0.461303
Adj. R-squared	0.141174	0.324450	0.070447	0.245825
Sum sq. resids	1.842225	2.08E+18	6.47E+09	4.72E+18
S.E. equation	0.303498	3.22E+08	17990.16	4.86E+08
F-statistic	1.575329	2.680966	1.265249	2.140832
Log likelihood	-1.182548	-603.9137	-319.8914	-615.7883
Akaike AIC	0.702245	42.26991	22.68216	43.08885
Schwarz SC	1.126578	42.69425	23.10650	43.51318
Mean dependent	0.040410	70422690	-7129.862	1.82E+08
S.D. dependent	0.327494	3.92E+08	18659.40	5.59E+08

Determinant resid covariance (dof adj.)	3.98E+41
Determinant resid covariance	9.00E+40
Log likelihood	-1531.954
Akaike information criterion	108.1348
Schwarz criterion	109.8321

Exhibit R8

Corrected from Robinson

Date	Face Value	Repo Lending	Net of Repo
4/1/2005	1,213,487,000	562,834,000	650,653,000
4/4/2005	1,400,267,000	563,534,000	836,733,000
4/5/2005	1,185,867,000	569,434,000	616,433,000
4/6/2005	1,192,237,000	586,834,000	605,403,000
4/7/2005	1,181,137,000	586,834,000	594,303,000
4/8/2005	1,186,037,000	565,434,000	620,603,000
4/11/2005	1,248,637,000	564,934,000	683,703,000
4/12/2005	1,247,737,000	539,734,000	708,003,000
4/13/2005	1,385,437,000	540,734,000	844,703,000
4/14/2005	1,332,537,000	540,734,000	791,803,000
4/15/2005	1,268,237,000	-81,100,000	1,349,337,000
4/18/2005	1,370,637,000	-79,400,000	1,450,037,000
4/19/2005	1,421,837,000	-77,600,000	1,499,437,000
4/20/2005	1,446,587,000	-58,100,000	1,504,687,000
4/21/2005	1,439,187,000	-88,900,000	1,528,087,000
4/22/2005	1,415,087,000	-106,250,000	1,521,337,000
4/25/2005	1,451,587,000	-104,850,000	1,556,437,000
4/26/2005	1,582,087,000	-107,150,000	1,689,237,000
4/27/2005	1,814,414,000	-107,150,000	1,921,564,000
4/28/2005	1,815,914,000	-107,150,000	1,923,064,000
4/29/2005	1,869,414,000	-87,250,000	1,956,664,000
4/30/2005	1,869,414,000	-87,250,000	1,956,664,000
5/2/2005	1,874,914,000	-87,250,000	1,962,164,000
5/3/2005	1,906,014,000	-76,750,000	1,982,764,000
5/4/2005	1,791,814,000	-76,750,000	1,868,564,000
5/5/2005	1,675,814,000	-78,050,000	1,753,864,000
5/6/2005	1,671,214,000	-76,350,000	1,747,564,000
5/9/2005	2,567,714,000	-76,350,000	2,644,064,000
5/10/2005	2,843,614,000	-78,150,000	2,921,764,000
5/11/2005	2,805,614,000	-78,150,000	2,883,764,000
5/12/2005	2,806,914,000	-55,350,000	2,862,264,000
5/13/2005	2,968,914,000	2,008,434,000	960,480,000
5/16/2005	2,962,214,000	2,297,622,000	664,592,000
5/17/2005	2,972,464,000	2,582,022,000	390,442,000
5/18/2005	2,971,664,000	2,559,222,000	412,442,000
5/19/2005	2,967,464,000	2,530,122,000	437,342,000
5/20/2005	3,404,064,000	2,521,634,000	882,430,000
5/23/2005	4,703,964,000	2,930,134,000	1,773,830,000
5/24/2005	6,062,272,000	3,987,972,000	2,074,300,000
5/25/2005	6,182,872,000	5,791,572,000	391,300,000
5/26/2005	6,072,072,000	5,821,272,000	250,800,000
5/27/2005	6,135,772,000	5,988,172,000	147,600,000
5/30/2005	6,135,772,000	5,988,172,000	147,600,000
5/31/2005	6,368,872,000	6,058,472,000	310,400,000
6/1/2005	6,359,672,000	6,122,672,000	237,000,000
6/2/2005	6,306,572,000	6,092,672,000	213,900,000
6/3/2005	6,303,822,000	6,316,172,000	-12,350,000

6/6/2005	6,303,822,000	6,342,722,000	-38,900,000
6/7/2005	6,289,922,000	6,342,722,000	-52,800,000
6/8/2005	6,379,272,000	6,324,922,000	54,350,000
6/9/2005	5,789,472,000	6,273,422,000	-483,950,000
6/10/2005	5,754,172,000	5,769,372,000	-15,200,000
6/13/2005	5,369,272,000	5,771,572,000	-402,300,000
6/14/2005	5,071,372,000	5,538,172,000	-466,800,000
6/15/2005	5,071,372,000	5,238,172,000	-166,800,000
6/16/2005	4,954,872,000	5,238,472,000	-283,600,000
6/17/2005	4,954,872,000	4,937,672,000	17,200,000
6/20/2005	4,950,372,000	4,934,372,000	16,000,000
6/21/2005	4,885,872,000	4,934,372,000	-48,500,000
6/22/2005	4,885,872,000	4,865,172,000	20,700,000
6/23/2005	4,885,872,000	4,867,472,000	18,400,000
6/24/2005	4,885,872,000	4,868,172,000	17,700,000
6/27/2005	4,885,872,000	4,868,172,000	17,700,000
6/28/2005	4,770,872,000	4,868,172,000	-97,300,000
6/29/2005	20,041,072,000	4,863,272,000	15,177,800,000

Exhibit R9

Year	Month	Peak Open Inter	Total Trading Volume
2000	3	608,971	9,387,192
2000	6	635,155	11,025,641
2000	9	607,620	9,666,832
2000	12	564,949	11,982,790
2001	3	560,230	13,109,568
2001	6	610,149	14,078,473
2001	9	576,191	13,181,322
2001	12	615,755	15,536,028
2002	3	561,146	17,207,708
2002	6	716,629	20,061,616
2002	9	914,917	26,568,450
2002	12	984,403	29,716,728
2003	3	769,112	26,076,941
2003	6	898,368	34,742,720
2003	9	1,004,540	42,100,602
2003	12	990,309	39,345,316
2004	3	1,159,103	37,788,258
2004	6	1,303,344	47,852,254
2004	9	1,418,972	43,888,647
2004	12	1,633,142	53,803,978
2005	3	1,660,665	46,044,404
2005	6	1,987,361	58,729,976

Exhibit R10